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Some Observations on the Distribution, Biology and Exploitation of the Norway Lobster (*Nephrops norvegicus* L.) in Scottish Waters

By H. J. THOMAS, B.Sc., Ph.D.

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me Observations on the Distribution, Biology and Exploitation of the Norway Lobster *(Nephrops norvegicus* L.) in Scottish Waters

INTRODUCTION

'he Norway Lobster (*Nephrops norvegicus* Leach) or prawn[1] is of general occurrence in British waters abundant in certain localities, but formerly the stocks were not commercially exploited to any :ant extent. In recent years, however, a market has developed in Britain and there has been a erable increase in the landings of the Norway lobster, from which certain vessels now obtain a while part of their income (Table 1). The total value of landings in Scotland during 1952 was ;20,000.

TABLE 1

The commercial landings (in cwt.) of Norway lobsters in Scotland during 1950-52.

	1950	1951	1952
South-east Scotland and Firth of Forth	1,153	2,199	2,844
Moray Firth	1,095	1,553	2,738
Firth of Clyde	646	429	128
Others (approximate)	100	100	120
Total	2,994	4,281	5,830
Average price per cwt.	37s.	54s.	72s.

ıvestigations on this species are desirable for two reasons, firstly, because interest attaches to the ıtion of any stock which is in the process of becoming exploited, and secondly, because it is possible ındings of the Norway lobster will continue to increase, making the species commercially more :ant.

cknowledgement is due to the Fishery Officers of the Scottish Home Department for their generous ration in supplying details of landings etc.

MATERIALS AND METHODS

ata giving the landings of the Norway lobster have been collected for all Scottish Fishery Districts h local Fishery Officers for the years 1950, 1951 and 1952. In addition, observations by the y Research Ship *Explorer* on the composition of the stock and measurements of the overall length ailable from certain grounds during the late twenties. The samples were obtained using an otter with small mesh attachment and thereby afford information on mesh selection.

he overall lengths and the corresponding carapace lengths were measured in a sample of .y lobsters taken in the Firth of Forth during June 1953 in order to provide conversion data for . length to carapace length, the latter being the more accurate and the conventionally accepted fic standard. Information on the distribution of the larvae is derived from analyses of research lankton hauls using 1 metre nets of mesh about 1 mm.

[1] ıe term "prawn" is used also, particularly in England, to designate *Palaemon seratus* and *Pandalus spp.* In order to avoid confusion : generally accepted name, Norway lobster, will be adopted.

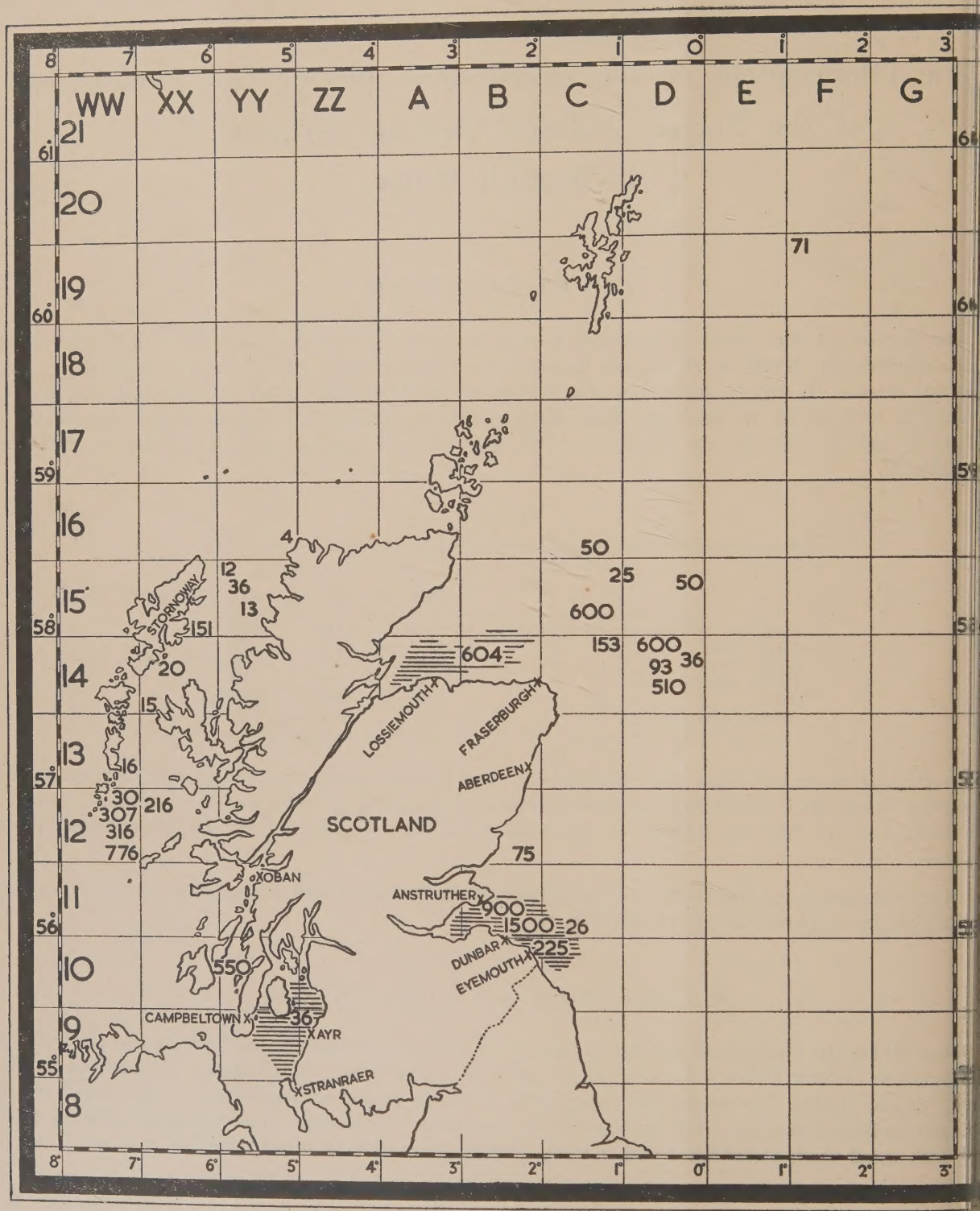


Fig. 1 The distribution and density of the adults of Norway lobsters in Scottish waters. The comm fishery (hatched) relates to 1952; numbers give landings of adult Norway lobsters taken in 70 otter trawl, with hauls of one hour duration, by Fishery Research Ship *Explorer* over the period 1952.

THE COMMERCIAL FISHERY

The commercial fishery for Norway lobsters in Scotland is centred mainly in three areas: the ickshire coast and Firth of Forth, the Moray Firth and the Firth of Clyde (Fig. 1). As will be seen able 1, these areas provide by far the greatest proportion of the total landings for Scotland.

The South-East Coast of Scotland and the Firth of Forth

Table 2 shows the sum of landings of Norway lobsters for the ports of Eyemouth, Dunbar and uther, by months, for the years 1950, 1951 and 1952.

The principal fishing grounds extend in a belt about a mile and a half wide from about 6½ miles from Eyemouth along the coast to the outer reaches of the Firth of Forth. The fishery from outh extends as far as 3½ to 4 miles north-east from Fastcastle Point. The focus of the Firth of fishery is around the May Island, particularly to the south and east.

The capture of Norway lobsters is mainly by smaller seine-net boats, up to 50 ft., and to a large t is incidental to the capture of white fish, although seiners also shoot with the primary object of g these shellfish. The net used is the standard Danish seine, the mesh being governed by regulations, n in the Eyemouth district provide for a mesh through which a flat gauge 70 mm. broad and n. thick shall pass easily when the net is wet, but to the west of May Island a minimum mesh of ximately 100 mm. is in force.

TABLE 2

The commercial landings of Norway lobsters from the south-east coast of Scotland and Firth of Forth, by months, for years 1950, 1951 and 1952.

Month	1950 Weight cwt.	1951 Weight cwt.	1952 Weight cwt.
January	101	19	143
February	93	61	187
March	23	39	429
April	13	7	117
May	43	1	13
June	25	1	101
July	157	74	312
August	121	243	451
September	268	470	516
October	81	535	211
November	129	282	169
December	99	467	195
Total	1,153	2,199	2,844

TABLE 3

The commercial landings of Norway lobsters at Lossiemouth from the Moray Firth, by months, for the years 1950, 1951 and 1952.

Month	1950 Weight cwt.	1951 Weight cwt.	1952 Weight cwt.
January	209	70	138
February	111	38	21
March	162	241	187
April	59	152	111
May	13	—	76
June	23	56	468
July	—	102	300
August	42	138	354
September	44	232	314
October	78	207	159
November	155	134	211
December	194	183	345
Total	1,095	1,553	2,684

TABLE 4

The commercial landings of Norway lobsters at Ayr from the Firth of Clyde, by months, for the years 1950, 1951 and 1952.

Month	1950 Weight cwt.	1951 Weight cwt.	1952 Weight cwt.
January	—	16	—
February	—	29	30
March	100	—	12
April	83	—	10
May	105	3	1
June	9	20	10
July	—	29	—
August	—	20	—
September	—	73	13
October	77	120	13
November	217	119	29
December	55	—	10
Total	646	429	128

(*b*) The Moray Firth

The bulk of the Norway lobsters captured within the Moray Firth are landed at Lossiem Table 3 gives details of these landings by months for the years 1950, 1951 and 1952.

The principal fishing grounds lie towards the south-east end of the Firth (Fig. 1). The fish prosecuted by seine-net boats using a net of 70 mm. mesh and is in the main incidental to the capt white fish. Certain smaller boats, however, frequently shoot with the prime object of capturing No lobsters.

In addition to the above, in 1952, 54 cwt. of Norway lobsters were landed at Fraserburgh fishing grounds about 10 miles north from Aberdour. Landings at other Moray Firth ports negligible.

(*c*) The Firth of Clyde

The main port at which Norway lobsters are landed from the fishing grounds of the Firth of C is Ayr. The landings at this port are given in Table 4, by months, for the years 1950, 1951 and

The capture of Norway lobsters is incidental to seine-net fishing for white fish. The size of employed is 70 mm. The principal areas are the middle grounds of the lower Clyde, around A and south to beyond Ailsa Craig. Occasionally, landings from these grounds are also made a adjacent ports of Stranraer, Portpatrick and Campbeltown, but the quantities landed at each of ports during the whole of 1952 averaged only about 7 cwt.

(*d*) Other Areas

Very occasional small landings of Norway lobsters were made during 1952 at most of the Scottish ports. The largest were at Aberdeen, where Swedish motor trawlers marketed 29 cwt. fishing grounds about 200 miles out. Belgian trawlers landed 22 cwt. from Icelandic waters, British trawlers landed 17 cwt. from North Sea grounds. In all cases the capture of Norway lo was completely incidental to that of white fish. Landings at Oban during 1952 totalled about 15 being taken by seine-net boats working in the Minch. About 10 cwt. were landed at Stornoway the seine-net grounds in the northern Minch from Tiumpan Head to near the Butt of Lewis. Lan at Lerwick by Shetland seine-net vessels operating locally, mainly in the neighbourhood of Burra totalled about 10 cwt. It is unlikely that the total landings outside the main grounds of the Fi Forth, Moray Firth and Firth of Clyde exceeded 120 cwt. in 1952, or 100 cwt. in either 1950 or (Table 1).

of Clyde during September 1927.

Data for otter trawl and small mesh attachment have been summed.

Overall length in cm.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
Males	—	0·26	0·22	0·42	1·36	3·42	8·58	11·64	10·83	9·36	7·21	5·38	4·36	3·67	2·82	2·33	1·90	1·20	0·90	0·27	0·04	0·02	76·19
Non-berried females	0·01	0·53	0·41	0·86	1·87	3·75	6·65	4·80	2·03	0·84	0·21	0·05	0·01	0·01	0·01	0·01	—	—	—	—	—	—	22·05
Berried females ..	—	—	—	—	0·01	0·08	0·63	0·53	0·25	0·17	0·03	0·01	0·02	—	—	—	—	—	—	—	—	—	1·73
All females	0·01	0·53	0·41	0·86	1·88	3·83	7·28	5·33	2·28	1·01	0·24	0·06	0·03	0·01	0·01	0·01	—	—	—	—	—	—	23·78
All classes	0·01	0·79	0·63	1·28	3·24	7·25	15·86	16·97	13·11	10·37	7·45	5·44	4·39	3·68	2·83	2·34	1·90	1·20	0·90	0·27	0·04	0·02	99·97
Percentage of berried females to total females	—	—	—	—	0·53	2·09	8·65	9·94	10·96	16·83	12·50	16·67	—	—	—	—	—	—	—	—	—	—	—
Sex ratio; percentage of total females to all classes ..	—	67·09	65·08	67·19	58·02	52·83	45·90	31·41	17·39	9·74	3·22	1·10	0·68	—	—	—	—	—	—	—	—	—	—

TABLE 6

The escapes of Norway lobsters from the 70 mm. mesh cod-end of an otter trawl into the small mesh attachment. Data relate to all classes taken in six hauls carried out in the Firth of Clyde during September 1927.

Length in cm.	3		4		5		6		7		8		9		10		11		12		13		14		15	
(Escapes = E.) (Retained = R.)	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.	E.	R.
Haul No. 1 ..	0	0	0	0	0	0	0	0	2	2	7	12	41	50	48	68	30	87	12	107	3	94	1	66	0	38
„ „ 2 ..	0	0	0	0	6	2	10	0	34	9	74	46	227	130	202	123	84	83	24	64	3	43	2	33	2	21
„ „ 3 ..	1	0	78	0	44	0	78	3	106	11	148	35	85	28	42	37	15	39	14	45	4	28	1	26	0	23
„ „ 4 ..	0	0	0	0	4	0	0	0	18	2	22	7	11	20	8	14	2	20	0	14	0	13	0	5	0	3
„ „ 5 ..	0	0	0	0	3	0	12	6	44	11	50	45	54	114	32	119	9	84	4	66	0	41	0	23	0	18
„ „ 6 ..	0	0	0	0	0	0	0	0	10	14	33	45	62	238	68	309	17	257	8	182	1	127	0	91	0	66
Totals	1	0	78	0	57	2	100	9	214	49	334	190	480	580	400	670	157	570	60	478	11	346	4	244	2	169
Percentage escapes..	100		100		96·6		91·7		81·4		63·7		45·3		37·4		21·6		11·1		3·1		1·6		1·2	

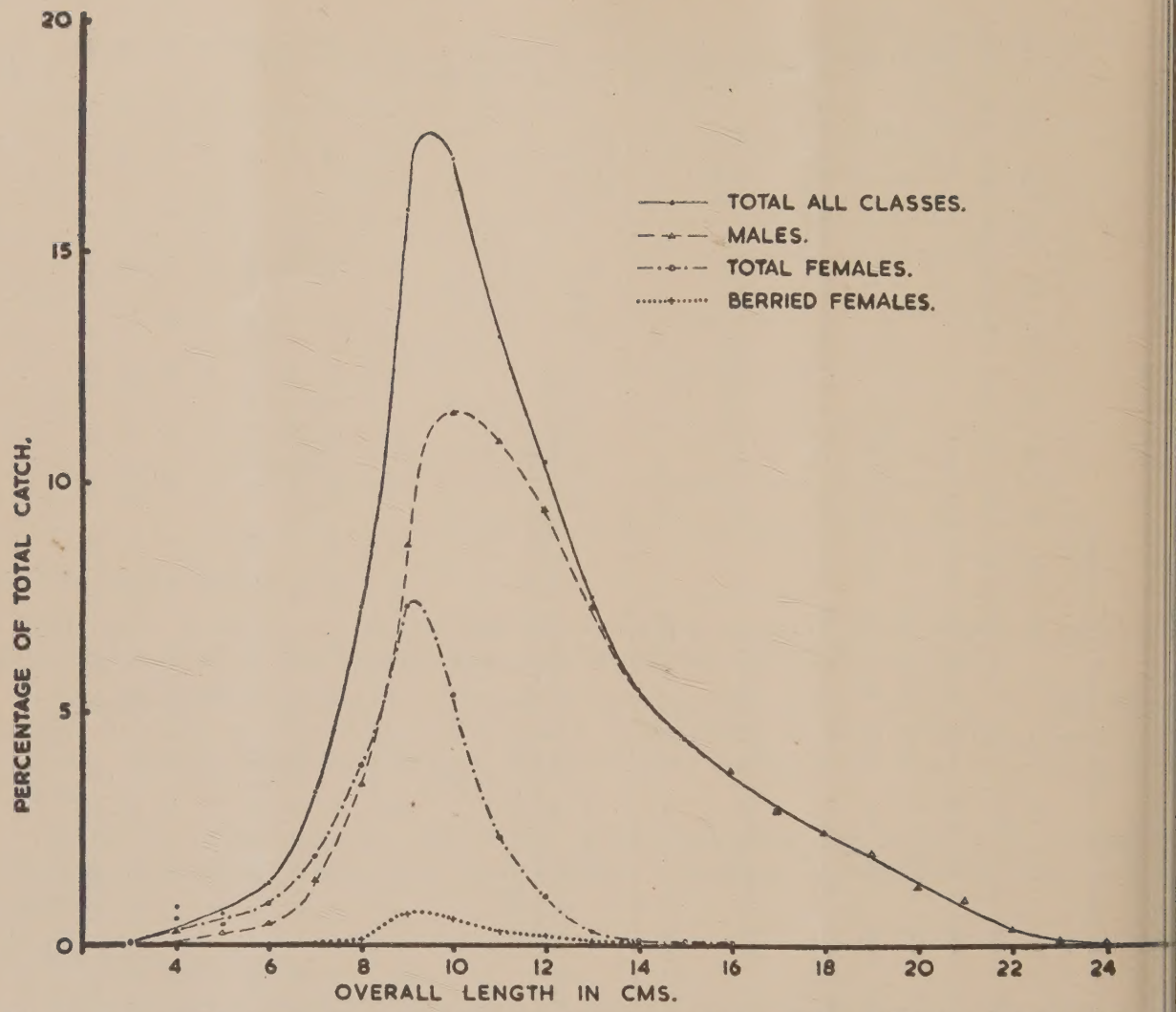


Fig. 2 The overall percentage composition, length and sex of 16 samples of Norway lobsters taken by otter trawl with small mesh attachment in the Firth of Clyde during September, 1927.

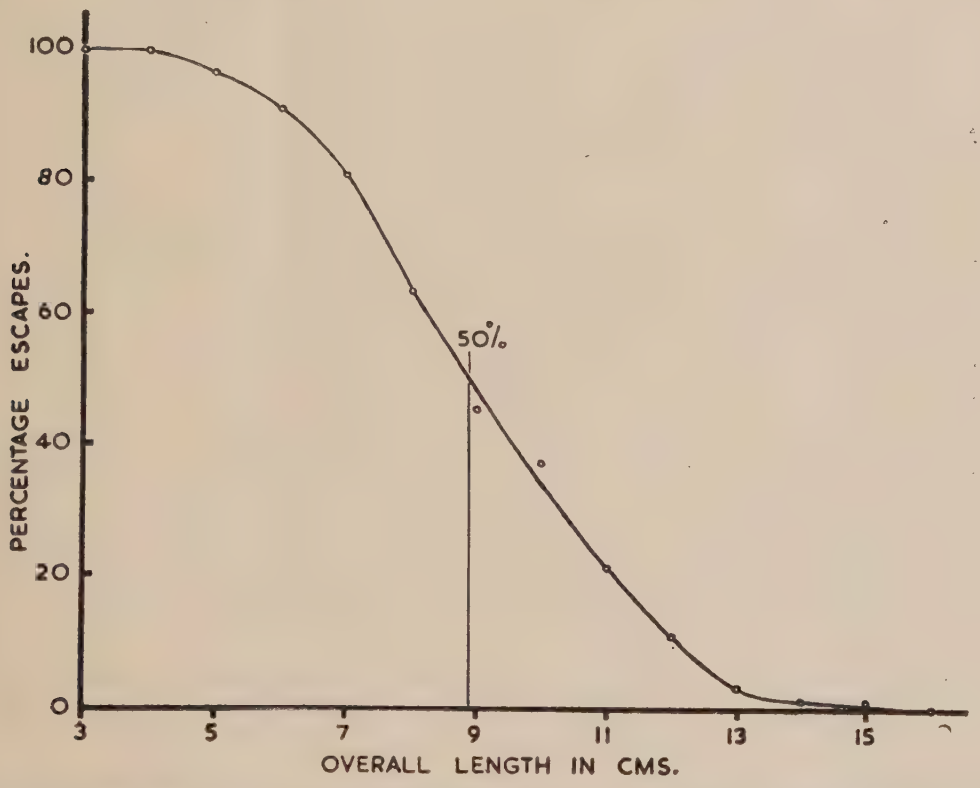
THE COMPOSITION OF THE STOCKS

Table 5 shows the overall percentage composition of 16 samples of Norway lobsters taken in the Firth of Clyde during September, 1927. Whilst there may be overall annual variations in the stocks, the data may be expected to reflect the principal features of natural populations in waters adjacent to Scotland.

The same data are reproduced in Fig. 2. The gear employed was an otter trawl with a 70 mm. cod-end mesh fitted with a small mesh attachment. The catches from both cod-end and small mesh attachment have been summed. It will be observed that the minimum length for berried females is 8 cm. From this point the proportion of berried females to total females increases up to about 15% at lengths above 12 cm. For lengths at which the female Norway lobsters are immature, the sex ratio shows a preponderance of females, but with the progressive increase in the proportion of berried females between lengths 8 and 12 cm. the overall sex ratio gradually becomes reversed and males predominate. The maximum recorded length for any female Norway lobster was 18 cm., and the proportion above 16 cm. was insignificant. In this length group only 0.7% of the stock were females. The males, on the other hand, were recorded up to an overall length of 24 cm. Whilst the possibility of migration cannot

ed, a reasonable explanation for the observed change in the sex ratio with increasing length, ; regard to the behaviour in other crustacea, is that with onset of maturity the moulting frequency onsequently growth) amongst females is reduced to a level well below that for males. Other obser- s on the sex ratio are given by Barnes & Bagenal (1951).

able 6 gives details of the escapes, by length groups for all classes of Norway lobster, into the mesh attachment from the cod-end of 70 mm. mesh in six hauls carried out in the Firth of Clyde ; September 1927. The same data are depicted in the graph Fig. 3. It will be seen that the elease point lies about overall length 9 cm. At this length 8.8% of the female Norway lobsters erried.



The percentage escapes by each centimetre length group of Norway lobsters through the 70 mm. cod-end mesh of an Otter trawl into the small mesh attachment in six hauls carried out in the Firth of Clyde during September 1927.

DISTRIBUTION

ULTS

ıe adult stage of Norway lobsters is of widespread occurrence in Scottish waters, mainly on s of mud or muddy sand. The location of the commercial fishing grounds is shown in Fig. 1, also indicates stations at which the Fishery Research Ship *Explorer* has taken specific quantities of y lobsters in an otter trawl during the period 1947 to 1952, inclusive, at all seasons. The intensity ɔling on the east of Scotland far exceeds that on the west. The data cannot necessarily be taken ring the full distribution of Norway lobsters, and, due to the limited research ship sampling, are table for investigation of seasonal changes in distribution. Apart from the commercially exploited s, Norway lobsters are relatively abundant in the area centred about 40 miles north-east from Buchan To the west of Scotland they are widely, though not densely, distributed throughout the Minch, considerable concentration exists in the south of this area to the west and south of Barra. In n to the commercially exploited grounds in the Firth of Clyde, the research ship records show a tration of Norway lobsters in the Sounds of Islay and Jura. The majority of hauls were taken hs ranging between 25 and 100 fathoms.

(*b*) Larval Stages

The occurrence of larvæ of Norway lobsters in the plankton hauls taken by the Fishery Reso
Ship *Explorer* during the years 1947 to 1952 inclusive, is shown in Fig. 4. In the routine sorting, estim

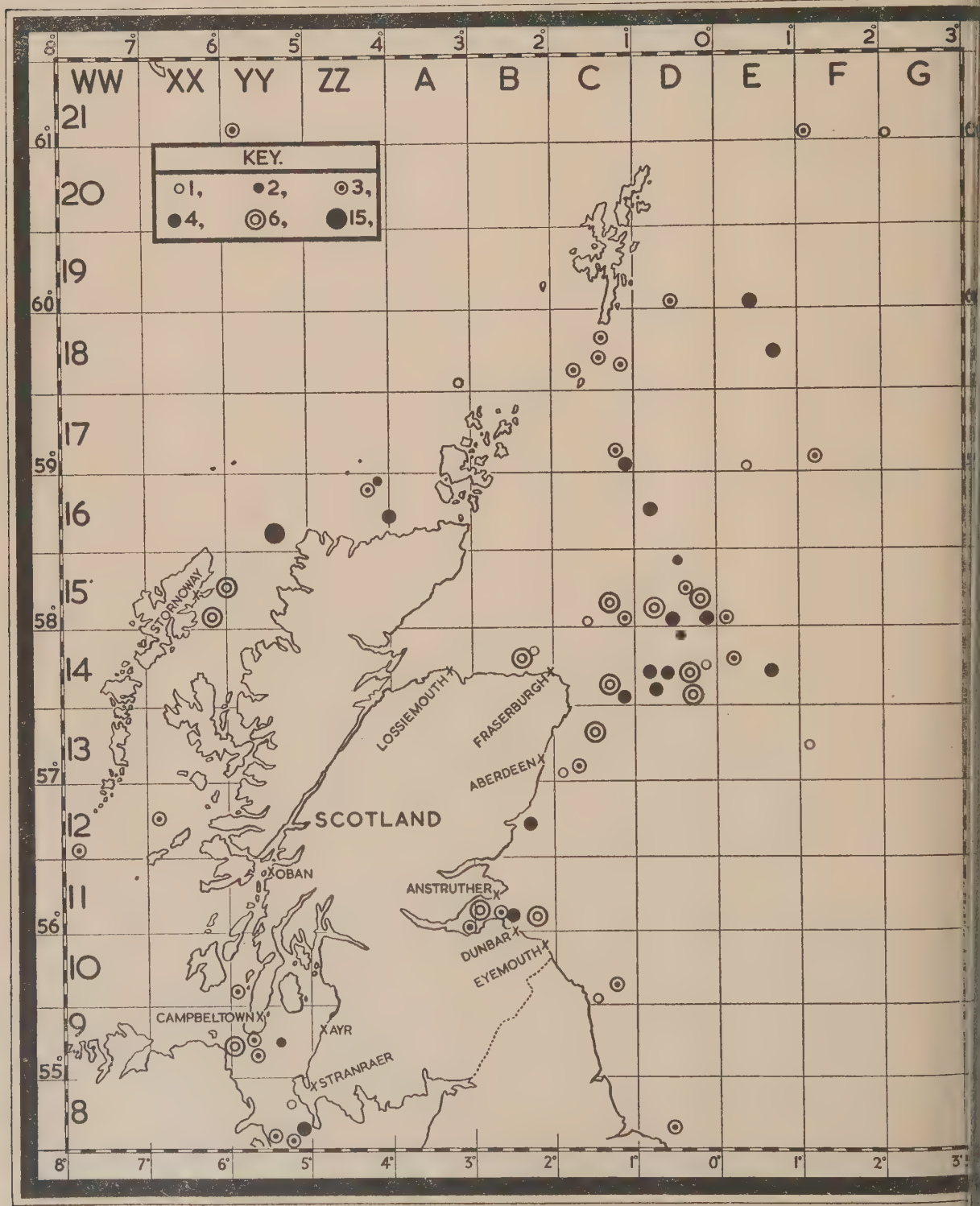


Fig. 4 The distribution and density of the larvæ of Norway lobsters in Scottish waters. Circles repr
the number of larvæ taken per fifteen minute plankton haul with a 1 metre net over the p
1947-1952.

een made of the larvæ of Norway lobsters, such as *rare, fair, common,* etc. These have been con-
vely interpreted numerically as in the figure.
able 7 shows the seasonal fluctuation in numbers of larvæ taken in the plankton hauls.

TABLE 7

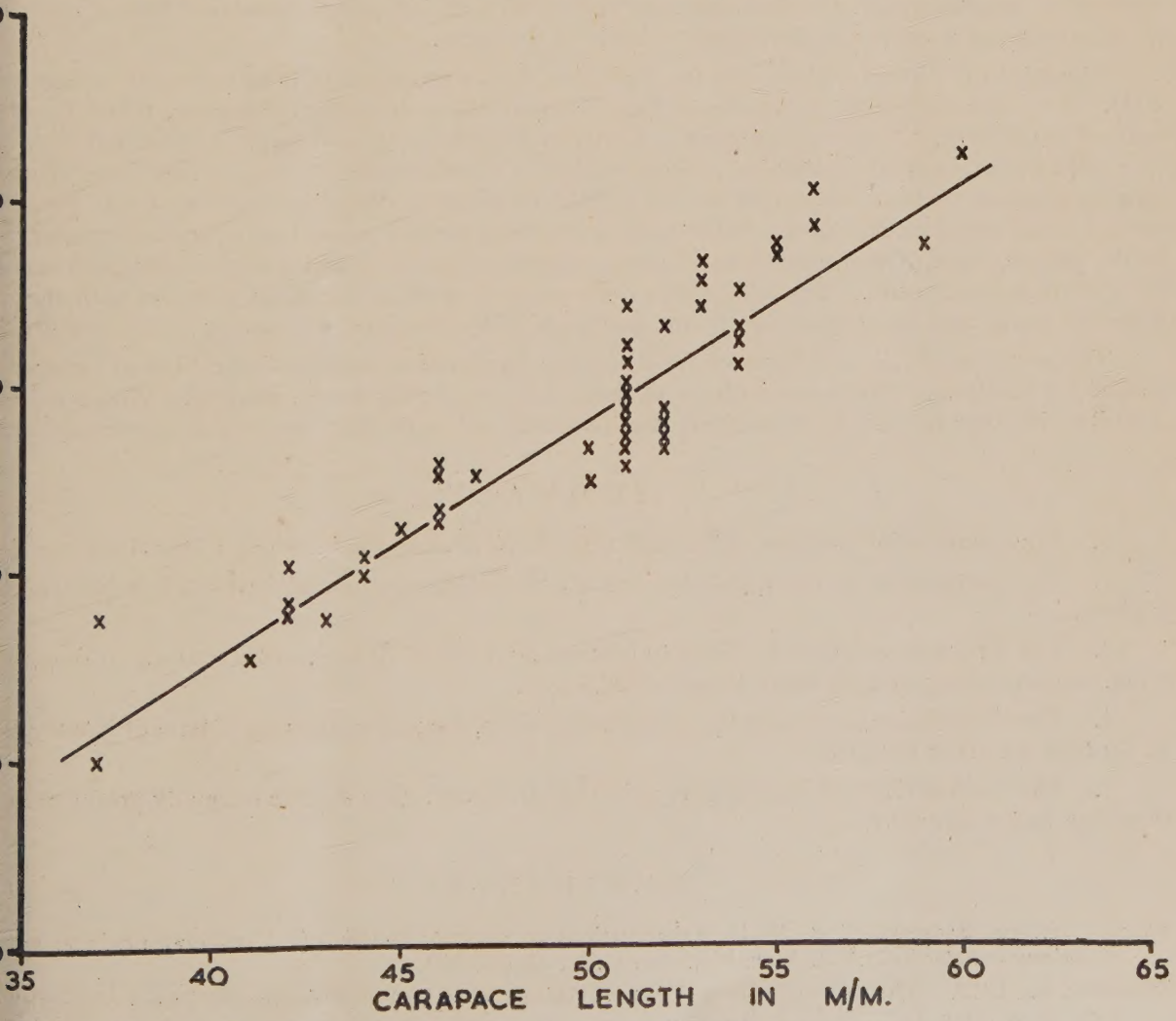
Approximate numbers of larval Norway lobsters taken in plankton hauls by Fishery Research Ship *Explorer* during the period 1947 to 1952, inclusive, by months.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
—	—	4	9	148	82	18	—	3	6	—	—

he main hatching season appears to be in May declining thereafter in June and July. In down to 50 fathoms there was no noticeable regular variation in density with depth. The ution of the larvæ corresponds roughly with the observed distribution of the adults.

ATIONSHIP OF OVERALL LENGTH TO CARAPACE LENGTH

view of the greater consistency in measurement of the carapace, it is customary to prefer this measurement of overall length. Fig. 5 shows the relationship between the length from the hinder



Norway lobsters. Regression of carapace length on overall length.

end of the eye socket to the mid dorsal point of the posterior end of the carapace, and the overall le from the tip of the rostrum to the end of the telson, excluding the setæ.

DISCUSSION

The increase in the price per cwt. of Norway lobsters in Scotland over the period 1950 to and the corresponding increase in landings suggest that the exploitation of this shellfish is like increase further. There appears to be scope for the extension of the fishery to populations not exploited. The fishery, at present, is largely incidental to the capture by seine-net vessels of white and any pronounced change in this relationship seems unlikely. On the other hand, given sui gear, there should be the possibility of a profitable Norway lobster fishery by small motor boats. a development might be of especial benefit on the west coast of Scotland where stocks at present u ploited are known to exist.

The regulations in Great Britain at present limit the seine-net when used for the capture of fish to a mesh through which a flat guage 70 mm. broad and 2 mm. thick shall be passed easily the net is wet. The law also provides that persons fishing for shellfish only are excluded from provisions. However, Norway lobsters are caught with these nets and a 70 mm. mesh correspond 50% release of Norway lobsters of about 9 cm. overall length, corresponding to a carapace leng 24.5 mm.; this allows for a proportion of females reaching maturity. On the other hand, con ation of a minimum permissible mesh size specifically suitable for Norway lobsters may be necessary should a fishery be developed exclusively for them.

The stocks of Norway lobsters in the Firth of Clyde were practically unexploited commercia 1927. The data for length composition (Fig. 2) recorded for that year, therefore, relate to an a natural population. The results suggest a relatively high natural mortality. This would, howeve decreased by commercial exploitation. Storrow (1912), describing the Norway lobster fishery from N Shields, suggests that the absence of berried females in winter is due to a migratory habit whereby are not taken in the trawl. Such a habit could account for the low percentage of berried females rec in the present data. On the other hand, there appears to be no need for such a theory to accou the variation in sex ratio. The falling off in the proportion of total females to males with the on maturity could also be attributable to the probable lower frequency of casting in the mature fe

The numbers of larvæ of Norway lobsters taken in plankton hauls indicate May as being the period for hatching. The concentration of larvæ falls off during June and July. Whilst a few are taken in other months, it seems likely that normally not more than one brood is produced ann

SUMMARY

1. The commercial landings of Norway lobsters in Scotland for the years 1950-1952 are det

2. The composition in respect of size and sex of a relatively unexploited stock of Norway lo is given.

3. The 50% release point for Norway lobsters by a net of 70 mm. mesh is at about overall l 9 cm. corresponding to a carapace length of 24.5 mm.

4. The distribution, as shown by research ship data, for both adults and larvæ of Norway l in Scottish waters is outlined.

5. The main period of hatching of eggs is May and June. The female normally produces not than one brood annually.

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